Environmental Studies Program: Studies Development Plan FY 2015-2017

Region: Headquarters

Planning Area(s): All

Title: Assessment of the Cumulative Effects of Anthropogenic Stressors on Marine Mammals

BOEM Information Need(s) to be Addressed: Whereas many investigations on the adverse effects of offshore activities on marine mammals address the immediate, acute impacts, less is known about the cumulative effects due to repeated and / or varied stress on these animals. A comprehensive review and synthesis of the scientific understanding to date of cumulative impacts and the methods used to evaluate them will give BOEM the ability to make more comprehensive impact assessments than has been done previously. BOEM's NEPA analyses and compliance with the Marine Mammals Protection Act and Endangered Species Act will be improved.

Approximate Cost: (in thousands) $300 **Period of Performance:** FY 2015-2016

Description:

Background: Potential interactions between marine mammals and anthropogenic sound are of concern to regulatory agencies, the environmental community, and the general public. There are many sources of anthropogenic sound in the ocean, from activities such as shipping, dredging and construction, oil drilling and production, geophysical surveys, and sonar from both civilian and military applications. In addition to sound, marine mammals may be exposed to a range of anthropogenic stressors and environmental changes. Other potential stressors include: toxicants, decreased prey abundance, and reduction in the quality or availability of habitat. The effect of a behavioral response on an individual animal's probability of survival or reproduction depend upon the animal's activities during the time of exposure (e.g., feeding, diving), attributes of the individual (e.g., age class, sex), physical condition, and its history of exposure to anthropogenic and natural stressors. And, of course the effect of a single stressor may be compounded by exposure to other stressors.

A promising approach to estimate cumulative effects of a given stressor is to link behavioral and/or physiological responses to vital rates (e.g., birth rates, juvenile survival, and adult mortality) by measuring body condition as a function of foraging success and energetics. Body condition is a state variable that responds to stressors and affects vital rates in both the short term and long term. Changes in behavior and/or physiology that reduce food intake or increase energy use can affect body condition. Over time, body condition will reflect the accumulated response to stressors. In many species, the reproductive success of females is limited by their energy stores, so variation in body condition can affect reproductive rate and survival of offspring. Changes in body condition can also affect survival via effects on the immune system.

A few years ago, the Office of Naval Research's (ONR's) Marine Mammals and Biology Program took the lead in an informal group of governmental and academic researchers

attempting to understand and model cumulative effects. Theirs was one of several such efforts, and there was not enough interaction among these groups to afford any one of them mutual benefit from the work done by the others. Consequently, ONR has proposed conducting a review and synthesis study on cumulative effects by the National Research Council's (NRC's) Ocean Studies Board, Division on Earth and Life Studies. The BOEM study proposed herein will co-fund the NRC review and synthesis.

Objectives: The objectives of this study are:

(1.) obtain a better understanding of the contribution of any one anthropogenic stressor to the cumulative impact of multiple stressors on individual marine mammals and marine mammal populations. (This is a fundamental problem in ecology that has not been solved and that is of direct relevance to environmental management.) ;

(2.) discover ways to quantify exposure-related changes in the behavior, health, or body condition of individual marine mammals ;

(3.) assess the potential to use indicators of health or body condition to estimate changes in vital rates and, in turn, estimate the potential population-level effects ; and

(4.) identify new approaches that could improve the assessment of cumulative effects.

Methods: A committee of approximately 8-9 subject matter experts will be recruited to review the present scientific understanding of cumulative effects of anthropogenic stressors on marine mammals and assess current methodologies used for evaluating cumulative effects. The committee will examine theoretical (modeling) and field methods used to assess the effect of anthropogenic stressors for:

(1.) short or infrequent exposure in the context of other known stressors (i.e. multiple stressors, both natural and anthropogenic); and

(2.) chronic exposure in the context of other known stressors.

This would include both direct and indirect effects from anthropogenic stressors and other environmental stressors.

The committee will meet 3 times over a span of 18 months to plan, gather information, deliberate, and prepare a final report. One of the meetings will include a public workshop as part of the data-gathering activities. The report will be subject to NRC review procedures prior to release. The committee will subsequently disseminate the report through briefings and presentations at scientific conferences.

Cost Justification: The total cost of the NRC review is approximately $600,000 . BOEM would be sharing half the cost. If other agencies are willing to co-fund this effort, BOEM's share of the cost would be reduced.

Revised Date: April 04, 2014